The Fat Floppy

Using a high-density floppy drive with your Amiga

by Phillip R. Combs

Amiga users have wanted high-density floppy disk drives in their systems for years. Dual-floppy users have longed for more space on their crowded boot floppies. CrossDOS users have desired access to 1.44MB MS-DOS floppies, and AMAX users have wished for high-density Macintosh floppy compatibility. It is now possible for Amiga 500 and 2000 owners to add one of Commodore's new high-density drives to their systems.

Although the high-density floppy can be found in some models of the A3000T, Commodore does not officially admit that the drives may be used in anything other than an A4000. Hours of experimentation, as well as information from an unnamed Amiga software developer, have made this project possible.

Background

Low-density Amiga floppy diskettes have a capacity of 880KB. These diskettes have 80 tracks with 11 sectors per track. High-density Amiga floppy diskettes have the same number of tracks as low-density diskettes, but have 22 sectors per track. This gives them a data capacity of 1.76MB. However, there is a big difference in the way the Amiga floppy drive handles each type of disk. I will use IBM-compatible floppies as an example, since the Amiga can handle this disk format using CrossDOS.

IBM-compatible 3.5" floppies are similar in that both high- and low-density diskettes have the same number of tracks. The high-density diskettes are also formatted with twice as many sectors per track as low-density diskettes. However, high- and low-density diskettes share the same rotational speed. This means that data being read from a high-density diskette has a higher data rate, or bandwidth, as the data read from a low-density diskette. IBM-compatible computers have no problems handling the higher data rate, as they use dedicated disk controller IC chips to handle disk operations.

The Amiga does not have a dedicated disk controller chip. On the A500 and A2000, disk control functions are distributed between the 8520 CIA chips and Gary. This design has remained almost unchanged from the A500 through the A3000, and it cannot handle the higher data bandwidth of high-density floppies.

How did Commodore add high-density floppies to the Amiga, given the hardware limitations? The answer is in creative engineering. The Amiga high-density floppy drive, a Chinon FB-357A (Commodore part number 313248-01), is a two-speed unit. High-density diskettes have an extra ID hole that distinguishes them from their low-density counterparts. When a low-density diskette is inserted, the high-density detection switch is closed, and the disk is treated as a low-density disk. When a high-density diskette is inserted the switch is not closed. The disk drive reduces its rotational speed by one-half. This allows twice as much data to be written to each track.

When the machine is powered up or rebooted, Kickstart does an equipment check to see what devices are attached to the system. The identification process for diskette drives is accomplished with the help of several 74-series logic chips on interface boards in external disk drives, and with circuitry on the Amiga motherboard. Kickstart goes through the following sequence to identify each attached disk drive:
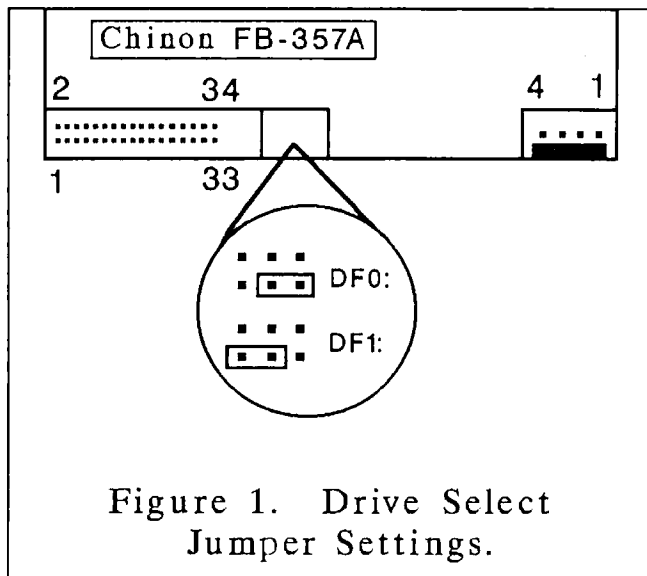
→

Figure 1. Drive Select Jumper Settings.

1) Drive MTRXD line low.
2) Drive SELxB line low.
3) Drive SELxB line high.
4) Drive MTRXD line high.
5) Drive SELxB line low.
6) Drive SELxB line high.
7) Drive SELxB line low.
8) Read and save state of RDY line.
9) Drive SELxB line high.

Steps 6 through 9 are repeated 15 times more. The 16 values for the RDY line are then converted into a 16-bit word, with the first value being the most significant bit. This 16-bit word is the drive ID.

Both high- and low-density drives identify themselves to the operating system as low-density drives at this point, sending an ID of $FFFF FFFF. When a high-density diskette is inserted into the drive and AmigaDOS reads the disk information, the drive reports that it's holding a high-density diskette by sending the ID $AAAA AAAA. AmigaDOS then writes data to the diskette with twice the number of sectors per track.

If the disk is going at half-speed, how can a program like CrossDOS make or read an MS-DOS diskette? CrossDOS writes to and reads from each disk track in the proper format at half-speed. When this diskette is placed into an IBM-compatible, it is in the proper MS-DOS format. AMAX handles Macintosh high-density floppies in a similar manner, although the Macintosh uses a different method of data encoding from the Amiga or IBM machines.

Now for the big question: can an IBM-compatible floppy drive be modified to work in the Amiga? The answer is no. The half-speed trick makes the drive different. IBM-compatible drives are designed from the ground up for one speed. For reliable data transfer, the diskette's rotational speed must be constant. Mechanical factors, such as flywheel weight and balance, as well as electrical factors like speed control, must be taken into consideration. You might be able to halve the motor speed, but the flywheel weight and motor torque wouldn't be optimized for the speed difference. This would result in data jitter, making reliable disk operations almost impossible. The Chinon drive was designed to run at either speed.

Unfortunately, Amiga users are locked in to Commodore as a source for these drives. Chinon America knows the drive is their product, but claim they know nothing specific about it. Chinon

Japan did not answer my inquiries. When I asked Chinon dealers about ordering this drive for me, Chinon America told them it was "discontinued." An OEM agreement between Commodore and Chinon Japan is probably behind the confusion.

Installing the high-density drives internally on an A500 or A2000 is almost as simple as plugging them in. Several software requirements must be met before the drives may be used. The drives will work only on machines with Kickstart v37.175 installed, and you must be using AmigaDOS 2.0 or later. If you meet these two conditions, you also need a shareware program called HDFixer. This program may be found on Fred Fish disk 806. If you have a later version of Kickstart, or you are using AmigaDOS version 2.1, HDFixer is unnecessary.

This project was tested on an A500 (revision 6a motherboard) and A2000 (revision 6.2 motherboard) that had 1MB of Chip RAM installed.
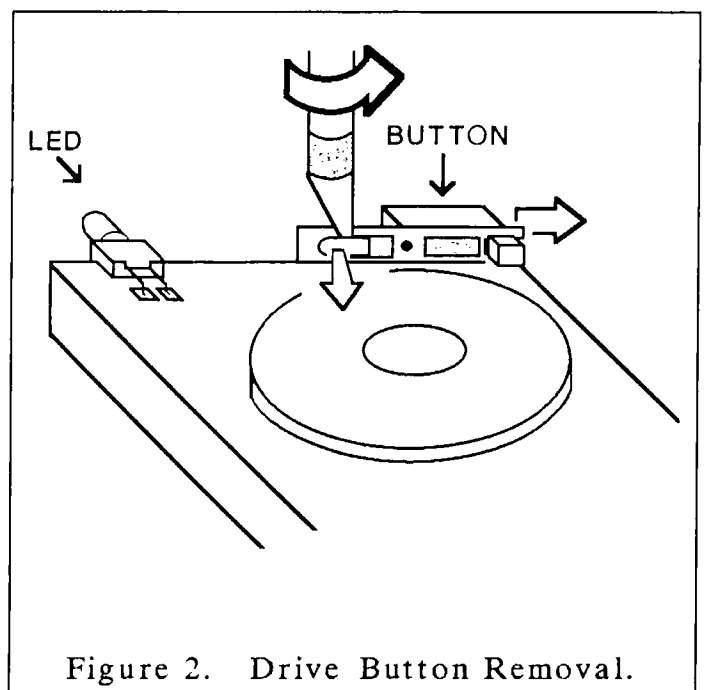
Internal Installation

There is one hitch with this conversion. The only high-density drive model commonly available now is the A3000T internal unit. This drive has no faceplate, the wrong LED, and the wrong eject button. Simply changing the button and removing the LED is enough for A500 conversion. For the A2000 you need a faceplate, button, and LED. You can exchange these parts from your old drive, but the outer case of the A3000T high-density drive lacks the proper holes to attach a faceplate. This means that you will need to swap the outer cases of your old low-density drive and your new high-density drive.

I will first describe how to install these drives in your A500 and A2000. Then I will describe the best way to install these drives externally.

1) Disassemble your computer to allow access to the internal floppy drive(s). A500 owners need to remove the top case and keyboard. A2000 owners will remove the top case.

2) Next, remove the existing floppy drive(s). On the A500, you need to remove two screws on the underside of the case and one screw on the drive's side nearest the keyboard. Unplug the power and data cables and remove the drive. A2000 owners need to remove the drive power supply platform. Remove the four mounting screws on the rear chassis for the power supply, and the

Figure 2. Drive Button Removal.

three screws by the floppy drives on the front chassis. Unplug the power cables and the floppy control cables from the drives, then remove the platform from the chassis. Remove the floppy drive mounting plate by removing four screws, then lift the platform straight off. Remove the drive(s) from the plate by removing the four screws holding each drive to the plate.

3) Remove the two standoffs (A500 drive) or four standoffs (A2000 drive) from the drive case. Look at the high-density drive's rear case and Figure 1. The figure shows the drive select jumper positions. If the drive will be mounted externally, in an A500, or as DF0: in the A2000, the jumper should be in the DF0: position. The only time you need to set the jumper to the DF1: position is when you mount the drive as DF1: in the A2000.

4) Remove the black screw on the top of the low-density floppy drive's case. Notice that the screw goes through a metal tong on the drive mechanism, then fastens to the case. This will be important later. Next, remove the single screw on each side of the case.

A2000 floppy drives will require faceplate removal at this point. With the drive lying upside down, look at the case sides near the faceplate. You should see a beige-colored plastic tab sticking through a hole on each side. Gently press the tab in, and that side of the faceplate should pop loose. You should then be able to tilt the faceplate away from the button and unhook the top edge. Use care, or you might crack the faceplate. Slide the drive mechanism out through the open end of the case. Repeat this disassembly procedure for the high-density floppy drive.

5) Orient the high-density floppy drive mechanism as shown in Figure 2, upside-down with the eject button facing away from you. Insert a thin knife blade between the eject button's mounting tongue and the button mounting plate. Carefully rotate the knife blade counterclockwise, just enough to lift the bump on the tongue out of the matching hole in the plate. Slide the button to the right and remove it. Repeat the procedure to remove the low-density drive's eject button.

6) Look carefully at the high-density drive's eject button mounting plate and the two eject buttons. The low-density drive's button is narrower than the new drive's button. It should be obvious which set of mounting holes that your old eject button will install into. The square block on the button's side will fit into the notch on the plate's side. Insert the button's mounting tongue into the proper rectangular hole, and slide the button to the left. Make sure the square block fits into the notch. When the button is properly seated, the tongue's bump will fit into the matching hole in the plate.

7) Next you will remove the round LED from the high-density drive. A500 owners will not need the LED. The LED's leads are routed through a black plastic clip that hooks over the front edge of the motor control board, and fastens around a switch assembly. Remove the LED by heating each lead where it fastens to the PC board with a soldering iron, then pull it away using needlenosed pliers or forceps. Next, gently spread the clip's mounting ears away from the switch housing, and slide the clip toward the front of the drive about 1/8". The mounting ears will then rest in recessions on the switch assembly. The clip's front edge should then be free from the edge of the PC board. Remove the clip and LED by lifting them straight up and away from the drive, then remove the LED from the clip.
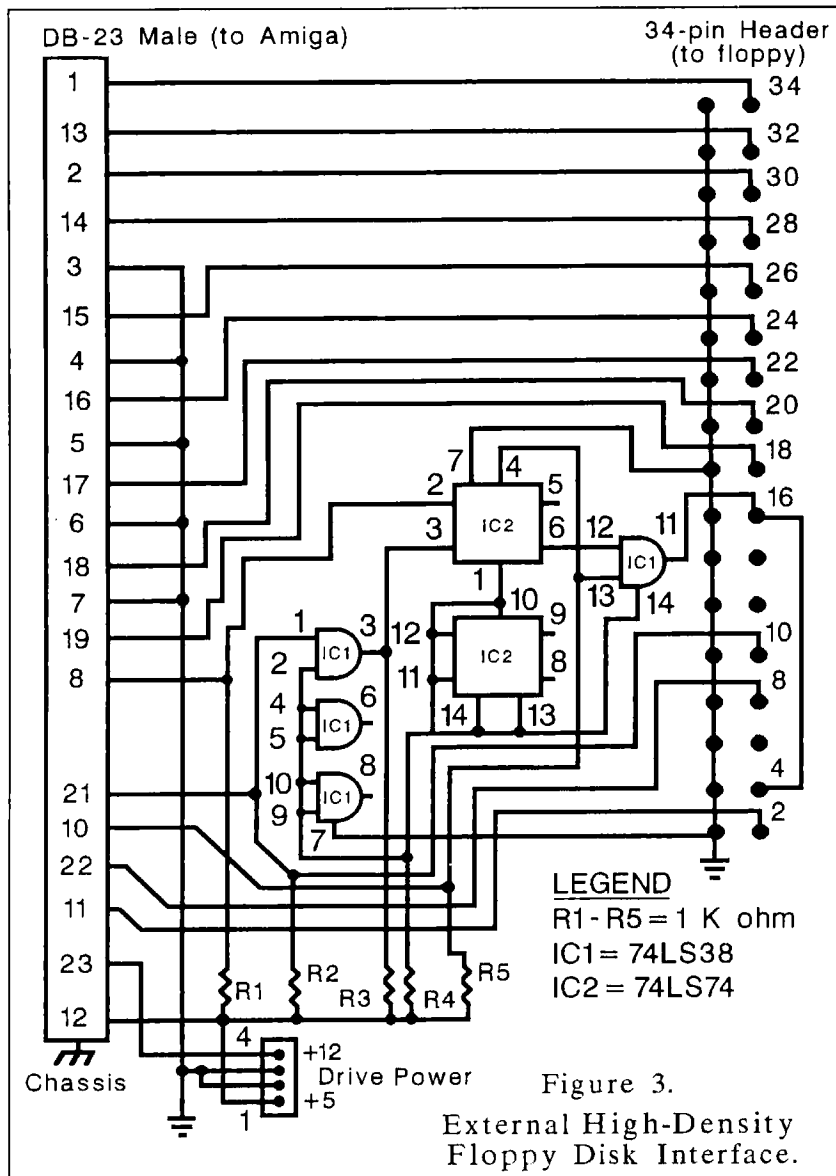

Figure 3.
External High-Density
Floppy Disk Interface.

LEGEND
R1 - R5 = 1 K ohm
IC1 = 74LS38
IC2 = 74LS74

8) A2000 owners need to substitute the rectangular LED from the low-density drive in the clip. Reverse the procedure in the previous step to mount the rectangular LED on the high-density drive. Make sure the LED fits snugly against the clip when soldering its leads to the PC board.

9) Insert the high-density mechanism into the low-density drive's outer case. Make sure the mounting tong on the drive mechanism goes over the tab on the case's top. The black screw should go through this tong and fasten to the tab. If the tong is placed under the tab, the drive mechanism will be misaligned in the case. This will make it difficult to insert and remove diskettes.

If you are upgrading A2000 drives, you will need to attach the faceplate at this point. Orient the faceplate so that the hooks on the top edge can easily catch the matching holes on the case. Swing the bottom edge of the faceplate toward the case, and it should snap into place. If it doesn't, gently spread the case sides apart by the faceplate and try again.

Attach one screw in each case side, and replace the two or four standoffs in the case bottom.

10) A500 owners may now reinstall their drive after first reattaching the power and drive cables. You can then reassemble the computer.

11) A2000 owners may mount their modified drive(s) to the mounting plate, then attach the mounting plate to the drive platform.

12) If you are installing a high-density floppy as DF1: in an A2000, you will need to remove a motherboard jumper. When this jumper is on, it enables the low-density drive ID circuitry. This circuitry is unnecessary with your new drive. You will remove either J301 or J36, depending on your motherboard revision. Jumper J301 is located near the internal floppy drive connector on the motherboard. Jumper J36 is located near the Paula (8364) chip, between ICs U15 and U16, toward the back edge of the motherboard.

13) A2000 owners may replace the drive platform now. Reattach the power and drive cables to each floppy drive, then replace the top case.

14) Now you are ready for the software part of the installation. If you have Kickstart 37.175 and AmigaDOS 2.0, you will need the shareware program HDFixer v2.0 from Fred Fish disk 806. This program is necessary due to a bug in the AmigaDOS 2.0 trackdisk.device. AmigaDOS can recognize and format the disk, but rootblocks are not written reliably. HDFixer patches Kickstart to correct this bug. Simply copy the program from floppy disk to your hard drive, or to your AmigaDOS 2.0 boot floppy. Drag the HDFixer icon to the WBStartup folder, then reboot your computer. Complete setup instructions and program options are discussed in the HDFixer documentation.

If you are using AmigaDOS 2.1, you do not need HDFixer. The rootblock bug was fixed in this release.

15) Insert a blank, high-density floppy diskette into the new drive. Highlight the diskette icon with a single mouse click, then select Disk-Format from the Workbench menu. The requester box should show the disk capacity as 1.76MB. Select Format, then go get a cup of coffee. This will take a while, as the disk is going at half-speed. When you return, copy some files to the diskette and try running or reading them. Your installation is complete.

External Installation

Installing the high-density drive in your A1010, A1011, or third-party external drive unit is possible. The procedure varies from model to model. The A1010 drives did not use Chinon mechanisms, so the drive buttons are not interchangeable. You will have to cut a wider hole in the front panel to accommodate the new drive's button. The holes in the mounting plate will not match, so you will have to trial-fit the new drive and drill new holes. The A1011 may use several types of drive mechanisms, but the mounting holes and buttons may be compatible. Third-party drives usually come with integrated front panels that will not fit your new drive. For these reasons, I cannot give you specific instructions on installing the new drive. You can still follow the above instructions for general guidelines. The software instructions will apply to your new external drive.

If you are installing the new drive in an existing external case, you will need to modify the drive adapter board to disable to low-density ID circuitry. Since external drive adapter boards are designed differently, you will need a volt-ohm-meter (VOM) with continuity beeper to assist you. Most adapter boards have several 74-series ICs on them. You will use the VOM to find which IC pin connects to pin 1 on the DB-23 plug.

Connect one VOM lead to pin 1 of the DB-23, and touch the other VOM lead to each IC pin. When the continuity beeper sounds, you have found the correct pin. Use a pair of small flushcutters to clip the IC pin near the chip body. Once this is done, you may install the new drive and reassemble the case.

If you wish to use the high-density drive externally but do not currently own an external drive, you need to build the drive interface shown in Figure 3. Sources for the DB-23 are shown in Table 1. The other parts are commonly available. You will still need to find a suitable faceplate for the high-density drive.

Conclusion

It took a long time for high-density drives to come to the Amiga, but they're finally here. Use them for archival file storage, hard disk backups, or boot floppies stuffed with your favorite utilities. Any way you use it, the high-density floppy is one more way to preserve your existing computer investment.

Special thanks to Bill Conn, of Merical Computers and Software in Centerville, Ohio, for his assistance with the research for this article.

Suppliers of DB-23 External Floppy Drive Connectors

Benetech Electronic Supply
1655 "B" Hickory Drive
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